



SUMMER- 18 EXAMINATION

Model Answer

Subject Name: Environment Technology

Subject Code: 17646

**Important Instructions to examiners:**

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
- 6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	A	Attempt any three of the following	12
	a	<b>Sources of air pollution (any eight)</b> 1. Industries 2. Transportation 3. Burning of fossil fuel and fires 4. Agricultural activities 5. Solid waste disposal 6. Construction activities 7. Deforestation 8. Solid waste disposal	½ mark each for any eight
	b	<b>Physical Characteristics of waste water:(any 4)</b> i) Temperature ii) Odor iii) Color iv) Total dissolved solids v) Turbidity  <b>Explanation (any one)</b> <b>Temperature:</b> The temperature of water is a very important parameter because of its effect on chemical reactions and reaction rates, aquatic life, and the suitability of the water	2  2 marks for any one



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for beneficial uses. Increased temperature, for example, can cause a change in the species of fish that can exist in the receiving water body. In addition, oxygen is less soluble in warm water than in cold water. The increase in the rate of biochemical reactions that accompanies an increase in temperature, combined with the decrease in the quantity of oxygen present in surface waters, can often cause serious depletion in dissolved oxygen concentrations in the summer months.

**Odor:** Odors in domestic wastewater usually are caused by gases produced by the decomposition of organic matter or by substances added to the wastewater. Industrial wastewater may contain either odorous compounds or compounds that produce odors during the process of wastewater treatment. The importance of odors at low concentrations in human terms is related to the psychological stress they produce rather than to the harm they do to the body. Offensive odors can cause poor appetite for food, lowered water consumption, impaired respiration, nausea and vomiting, and mental perturbation.

**Color:** Fresh sewage is typically gray in color. However, as the travel time in the collection system increases, and more anaerobic conditions develop, the color of the wastewater changes sequentially from gray to dark gray and ultimately to black.

**Turbidity:** Turbidity, a measure of the light-transmitting properties of water, is another test used to indicate the quality of waste discharges and natural waters with respect to colloidal and residual suspended matter. The measurement of turbidity is based on comparison of the intensity of light scattered by a sample as compared to the light scattered by a reference suspension under the same conditions.

c **Pollutants from urea plant (any two)**

- Oil and grease
- Ammonia
- Fluorides
- Phosphate
- NaOH
- Urea

From above pollutants urea and ammonia are causing serious health effects of human.

2 mark each  
for any two  
pollutant with  
effect



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1. Urea can be irritating to skin, eyes, and the respiratory tract. Repeated or prolonged contact with urea in fertilizer form on the skin may cause dermatitis.
2. The substance decomposes on heating above melting point, producing toxic gases, and reacts violently with strong oxidants, nitrites, inorganic chlorides, chlorites and perchlorates, causing fire and explosion.
3. Ammonia is irritating and corrosive. Exposure to high concentrations of ammonia in air causes immediate burning of the nose, throat and respiratory tract. This can cause bronchiolar and alveolar edema, and airway destruction resulting in respiratory distress or failure.

**d Classification of solid waste**

<b>Types</b>	<b>Example of sources</b>
Food wastes	Animal, fruits and vegetable residues resulting from the handling and preparation, cooking and eating of foods
Rubbish	1. combustible papers, plastics, leather, cardboard, wood, rubber etc. 2. Non-combustible glass, aluminium cans ,crochery, tin cans , dirt, construction wastes.
Ashes and residue	Material remaining from the burning of wood, coal, and coke and other combustible wastes in homes, stores, industrial and municipal facilities for the purpose of heating and cooking
Demolition and construction waste	Wastes from construction, remoulding, repairing of residential , commercial and industrial buildings
Special waste	1. street sweepings. 2. road side litter from municipal litter containers. 3. Dead animals
Treatment plant waste	From water, wastes water and industrial waste treatment plants
Hazardous wastes	Chemical Biological Flammable



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		explosive		
		Agricultural wastes	Planting Harvesting of crops, fields etc.	
1	B	<b>Attempt any one of the following</b>		6
	a	<b>Use of Electrostatic precipitator</b>  Electrostatic precipitator is used for the collection of dust, fumes and smoke from gaseous emissions in <ul style="list-style-type: none"><li>• Steel industry</li><li>• Metallurgical industry</li><li>• Cement industry</li><li>• Kraft paper mill</li><li>• Sulfuric acid plant</li><li>• Petroleum refinery</li><li>• Power plant</li></ul> These uses are based on working principle. Electrostatic precipitation is a method of dust collection that uses electrostatic forces, and consists of discharge wires and collecting plates. A high voltage is applied to the discharge wires to form an electrical field between the wires and the collecting plates, and also ionizes the gas around the discharge wires to supply ions. When gas that contains an aerosol (dust, mist) flows between the collecting plates and the discharge wires, the aerosol particles in the gas are charged by the ions. The Coulomb force caused by the electric field causes the charged particles to be collected on the collecting plates, and the gas is purified. This is the principle of electrostatic precipitation, and Electrostatic precipitator apply this principle on an industrial scale.		6
	b	<b>Methods for collecting solid waste</b> <b>Communal storage point:-</b> Waste is collected in concrete bins located at one point. Daily it is transferred to deposal area by vehicle. <b>Block collection:-</b> in block collection the waste is brought in a container by individuals to a waiting vehicle which travels a regular route twice or thrice a week. The containers are		6





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		6	Magnesium	50	150		
		7	Iron	0.3	1.0		
		8	Copper	1.0	1.5		
		9	Sulphate	200	400		
		10	Phenols	0.001	0.002		
			Toxic				
		11	Arsenic	-	0.2		
		12	Chromium	-	0.05		
		13	Cyanide	-	0.01		
		14	Lead	-	0.1		
	c	<b>Effect of Thermal pollution</b> i) Reduction in dissolved oxygen ii) Decreases the oxygen saturation percentage iii) Increase in BOD iv) Early hatching of fish eggs. v) Failure of trout (cold water fish) eggs to hatch and salmon to spawn vi) Direct fish mortality due to failure in respiratory, nervous or essential cell processes. vii) Bacteria multiply rapidly, which in turn become the food of protozoans. viii) Undesirable changes in algal population. ix) Excessive eutrophication. x) increases the toxicity of some chemical pollutants xi) migration of aquatic biota xii) Decrease in solubility of gases in water. xii) Rapid setting of sediment load in water affecting aquatic food supply.					1 mark each for any four
	d	<b>Activated sludge process</b> <b>Principle</b> - a biological wastewater treatment process which speeds up waste					4



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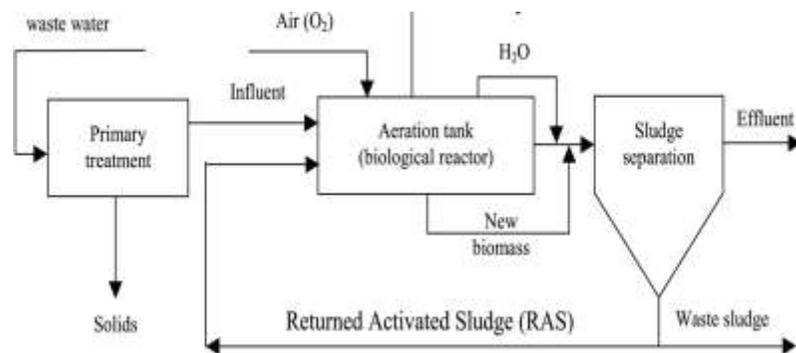
decomposition. Activated sludge is added to wastewater, and the mixture is aerated and agitated. After a certain amount of time, the activated sludge is allowed to settle out by sedimentation and is disposed of (wasted) or reused (returned to the aeration tank)

**Working**

A basic activated sludge process consists of several interrelated components:

- An aeration tank where the biological reactions occur
- An aeration source that provides oxygen and mixing
- A tank, known as the clarifier, where the solids settle and are separated from treated wastewater

Aerobic bacteria thrive as they travel through the aeration tank. They multiply rapidly with sufficient food and oxygen. By the time the waste reaches the end of the tank (between four to eight hours), the bacteria has used most of the organic matter to produce new cells. The organisms settle to the bottom of the clarifier tank, separating from the clearer water. This sludge is pumped back to the aeration tank where it is mixed with the incoming wastewater or removed from the system as excess, a process called wasting. The relatively clear liquid above the sludge, the supernatant, is sent on for further treatment as required



- e **Need of Environment audit**
- i) Environmental improvements
  - ii) Regulatory compliance
  - iii) Improvement of corporate image
  - iv) Cost containment & cost saving

1 mark each  
for any four



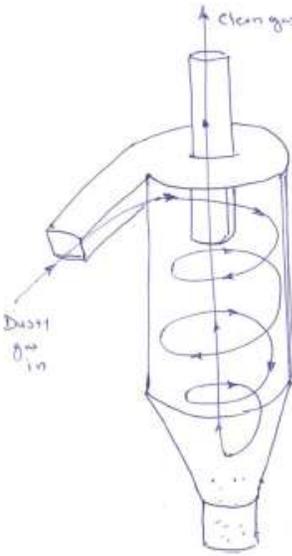
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		v) Competitive advantage vi) Opening of international market & partners vii) Improvement in employee awareness about environment viii) An ethical or social commitment	
3		<b>Attempt any four of the following</b>	<b>16</b>
a	<b>Working of cyclone separator</b> A dust laden gas enters in a cyclone separator takes spiral motion. It utilizes a centrifugal force generated by spinning gas stream to separate particle matter from the gas. The centrifugal force on a particles in spinning gas stream is much greater than gravity, there for it is effective in removing small particles. The gas spirals downwards to the bottom of the cone and at, and at the bottom the gas flow reverses to form an inner vortex which leaves through the outlet pipe. Cyclone separator is used to separate gas-solid, gas-liquid in Cement industry ,Oil refinery, Petrochemical Plant, Power plants, and Metallurgical Industry etc.		02
b	<b>Devices used for particulate sampling (any 2)</b> 1. Sedimentation (Dust Fall Jar) 2. High Volume filtration (High Volume Sampler)		2



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	<p>3. Tape Sampler 4. Electrostatic precipitation</p> <p><b>Grab Sampling</b> Grab Sampling method for gaseous pollutant: In grab sampling the sample is collected by filling an evacuated flask or an inflatable bag. Plastic bags have been widely used for grab sampling and for storage before analysis. Bag sampling is subject to losses caused by moisture condensation or diffusion through the walls of the bag. The losses can be minimized by performing the analysis immediately following collection. Grab samples may be taken using rigid wall containers made from glass or stainless steel. These containers are first evacuated and then filled by allowing air to enter. Alternatively, a container may be filled with water and then used as a collector simply by draining away the water which is replaced by the air sample.</p>	2
c	<p><b>Chemical Characteristics of waste water:(any 4)</b> i)Chemical oxygen demand(COD) ii) pH iii)Acidity or alkalinity iv) hardness v) Total carbon vi) Chlorine demand</p> <p><b>TDS:</b> - Total dissolved solids (TDS) is a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granular (colloidal sol) suspended form.</p>	½ mark each for any four  2
d	<p><b>Absorption sampling method for gaseous pollutant</b> Absorption in liquids: Absorption of gaseous pollutants into a liquid medium is probably the most commonly employed method of collecting the samples. Absorption separates the desired pollutant from air either through direct solubility in the absorbing medium or by chemical reaction. Many different types of collectors are in use, ranging from simple bubbles to complex devices which provide a high degree of gas liquid contact. In fritted glass absorber the gas stream is broken into extremely small bubbles thus promoting an intimate contact between the gas and the liquid. Frit designated coarse (50µm pore size) are most often used for air sampling. The glass frit can become blocked and is often</p>	4



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difficult to clean after use therefore it is often advisable to prefilter the air prior to sampling.

In the impinger the gas stream is impinged at high velocity into a flat surface thus providing good contact between the gas and the liquid. Absorption sampling method for gaseous pollutant:

e **Role of pollution control board :-**

1. To promote cleanliness of streams and wells in different areas of the States through prevention, control and abatement of water pollution;
2. To improve the quality of air and to prevent, control or abate air pollution in the country;
3. Advise the Government on any matter concerning prevention and control of water and air pollution and improvement of the quality of air;
4. Plan and cause to be executed a nation-wide programme for the prevention, control or abatement of water and air pollution;
5. Plan and organise training of persons engaged in programmes for prevention, control or abatement of water and air pollution;
6. Organise through mass media, a comprehensive mass awareness programme on prevention, control or abatement of water and air pollution;
7. Collect, compile and publish technical and statistical data relating to water and air pollution and the measures devised for their effective prevention, control and abatement;
8. Prepare manuals, codes and guidelines relating to treatment and disposal of sewage and trade effluents as well as for stack gas cleaning devices, stacks and ducts;
9. Disseminate information in respect of matters relating to water and air pollution and their prevention and control;
10. Lay down, modify or annul, in consultation with the State Government concerned, the standards for stream or well, and lay down standards for quality of air;
11. Establish or recognize laboratories to enable the Board to perform;
12. Perform such other functions as and when prescribed by the Government of India.

1 mark  
each for  
any four



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		13. To issue directions to any industry, local bodies, or other authority for violation of the notified general emission and effluent standards, and rules relating to hazardous waste, bio-medical waste, hazardous chemicals, industrial solid waste, municipal solid waste including plastic waste under the Environment (Protection) Rules, 1986.	
	f	<b>The control methods for sea water pollution</b> <i>Physical Method</i> i) Skimming the oil off the surface with a suction device ii) The floating oil can be absorbed using a suitable absorbing material like polyurethane foam. iii) Chemical can be used to coagulate the oil. iv) By spreading a powder of high density over the oil patch by which oil can be sunk to the bottom. v) Sand treated with stearate and 10% sand in water slurry removes the oil considerably.  <i>Chemical method:</i> Dispersion of oil is most satisfactory method for removing oil from the sea surface. Natural or chemical dispersion method can be used to control sea water pollution.	4
4	A	<b>Attempt any three of the following</b>	12
	a	<b>Trickling filter</b> A trickling filter is used for treatment of waste water. It consists of a bed of highly permeable media on whose surface a mixed population of microorganisms is developed as a slime layer. Passage of wastewater through the filter causes the development of a gelatinous coating of bacteria, protozoa and other organisms on the media. With time, the thickness of the slime layer increases preventing oxygen from penetrating the full depth of the slime layer. In the absence of oxygen, anaerobic decomposition becomes active near the surface of the media.  In diagram Sprinkler : To sprinkle waste water on filter Filter: To hold biological slime	02



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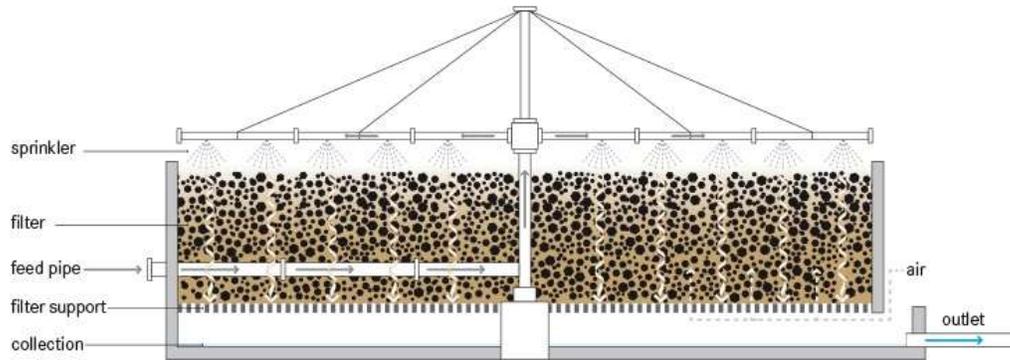
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Feed pipe : Inlet for waste water  
Filter support: To hold filter media  
Effluent channel: to take out treated waste water



02

**b The primary treatment methods for waste water**

1. Screening
2. Comminuting
3. Grit removal
4. Sedimentation

**Screening:** Screening is the first unit operation used at wastewater treatment plants (WWTPs). Screening removes objects such as rags, paper, plastics, and metals to prevent damage and clogging of downstream equipment, piping, and appurtenances. Some modern wastewater treatment plants use both coarse screens and fine screens. These consist of bars usually spaced three-quarter inches to six inches. Those most commonly used provide clear openings of one to two inches. Although large screens are sometimes set vertically, screens are usually set at an angle of 45 to 60 degrees with the vertical. The incoming wastewater is passed through the bars or screens and periodically the accumulated material is removed. The racks or screens may be cleaned either manually or by means of automatically operated rakes. The solids removed by these units can be disposed of by burial or incineration.

**Comminuting:** These are devices to break or cut up solids to such size that they can be

½ mark each

2 marks for  
any one  
method



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returned to the wastewater without danger of clogging pumps or piping or affecting subsequent treatment devices. They may be separate devices to grind solids removed by screens or a combination of screen and cutters installed within the wastewater flow channel in such a manner that the objective is accomplished without actually removing these larger solids from the wastewater. These latter devices are made by a number of manufacturers under various trade names and, in most cases, consist of fixed, rotating or oscillating teeth or blades, acting together to reduce the solids to a size which will pass through fixed or rotating screens or grids having openings of about one-fourth inch. Some of these devices are even designed to operate as a low-lift pump.

**Grit Removal:** Grit includes sand, gravel, cinder, or other heavy solid materials that are “heavier” (higher specific gravity) than the organic biodegradable solids in the wastewater. Grit also includes eggshells, bone chips, seeds, coffee grounds, and large organic particles, such as food waste. Removal of grit prevents unnecessary abrasion and wear of mechanical equipment, grit deposition in pipelines and channels, and accumulation of grit in anaerobic digesters and aeration basins. Grit removal facilities typically precede primary clarification, and follow screening and comminution. This prevents large solids from interfering with grit handling equipment.

**Sedimentation:** The purpose of sedimentation is to enhance the filtration process by removing particulates. Sedimentation is the process by which suspended particles are removed from the water by means of gravity or separation. In the sedimentation process, the water passes through a relatively quiet and still basin. In these conditions, the floc particles settle to the bottom of the basin, while “clear” water passes out of the basin over an effluent baffle or weir. The solids collect on the basin bottom and are removed by a mechanical “sludge collection” device. The sludge collection device scrapes the solids (sludge) to a collection point within the basin from which it is pumped to disposal or to a sludge treatment process. Sedimentation involves one or more basins, called “clarifiers.” Clarifiers are relatively large open tanks that are either circular or rectangular in shape. In



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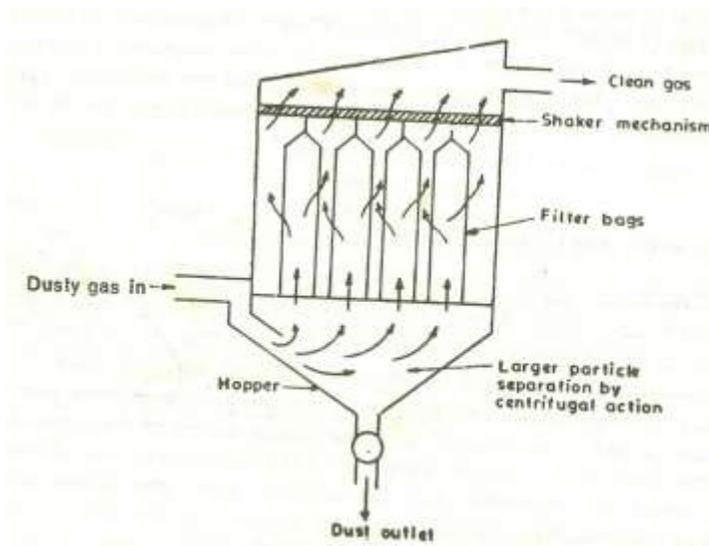
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properly designed clarifiers, the velocity of the water is reduced so that gravity is the predominant force acting on the water/solids suspension.

c **Working principle of fabric filter**

Dust-laden gas or air enters the fabric filter through hoppers (large funnel-shaped containers used for storing and dispensing particulate) and is directed into the fabric filter compartment. The gas is drawn through the bags, either on the inside or the outside depending on cleaning method, and a layer of dust accumulates on the filter media surface until air can no longer move through it. When sufficient pressure drop ( $\Delta P$ ) occurs, the cleaning process begins. Cleaning can take place while the fabric filter is online (filtering) or is offline (in isolation).



02

02

d **Objectives of Environment Management**

- Regulating the exploitation of natural resources.
- Protecting environmental degradation and maintaining environmental quality..
- Balancing the ecosystem.
- Preserving the biological diversity.
- Regulation of exploitation of natural resources.
- Adopting engineered technology without creating adverse effects on environment.
- Formulation of suitable environmental laws and regulations and effective implementation of the same.

1 mark each  
for any four



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<b>B</b>	<b>Attempt anyone of the following</b>	<b>6</b>
a	<p><b>Necessity of recovery of chemicals from black liquor because of</b></p> <ol style="list-style-type: none"><li>1) The dark color of the effluent is due to the lining compounds which are not easily biodegradable and hence it imparts persistent color to the receiving water streams and inhibits photosynthesis and other natural self-purification process of the water streams.</li><li>2) The immediate oxygen demand of the effluent brings about depletion of oxygen of the receiving stream create adverse effects to aquatic life.</li><li>3) The chemicals present in the effluent, e.g. sulfites, phenols, free chlorine, methyl mercaptant are harmful to fauna and flora of the receiving water.</li><li>4) The settleable materials present may sink to the bottom and interfere with aquatic life.</li><li>5) Raw material cost can be reduced after recovery of chemicals.</li></ol>	6
b	<p><b>Business Benefits of ISO14000:(any 6)</b></p> <ol style="list-style-type: none"><li>1. Efficiency, discipline and operational integration with ISO 9000</li><li>2. Greater employee involvement in business operations with a more motivated workforce</li><li>3. Easier to obtain operational permits and authorizations</li><li>4. Assists in developing and transferring technology within the company</li><li>5. Helps reduce pollution</li><li>6. Fewer operating costs</li><li>7. Savings from safer workplace conditions</li><li>8. Reduction of costs associated with emissions, discharges, waste handling, transport &amp; disposal</li><li>9. Improvements in the product as a result of process changes</li><li>10. Safer products</li><li>11. Minimizes hazardous and non-hazardous waste</li><li>12. Conserves natural resources - electricity, gas, space and water with resultant cost savings</li></ol>	1 mark each for any six



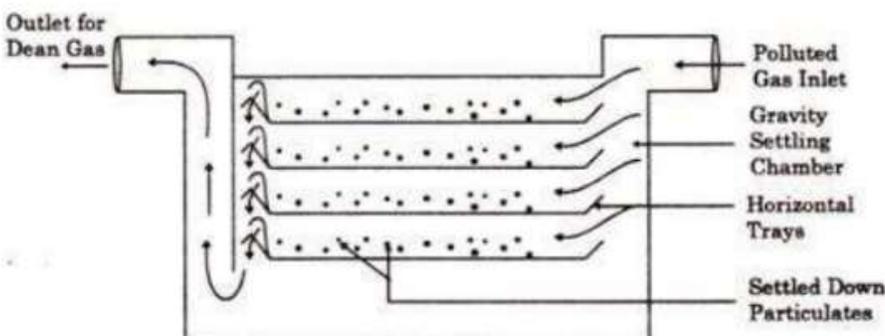
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5	<b>Attempt any four of the following</b>	<b>16</b>
a	<p><b>Gravity settling chamber</b></p> <p>Gravitational force may be employed to remove particulate in settling chambers when the settling velocity is greater than about 0.12m/s. Gravity settling chambers are provided with enlarged areas to minimize horizontal velocities and allow time for the vertical velocity to carry the particle to the floor. The gravitational settling chambers are usually operated with velocity between 0.5 to 2.5 m/s. Some settling chambers have simply enlarged conduits and some have horizontal shelves and baffles, spaced about 2.5cm apart. The horizontal shelves shorten the settling path of the particles and improve removal efficiency. Gravitational settling chambers are generally used to remove large, abrasive particles (usually &gt;50 <math>\mu\text{m}</math>) from gas streams. They offer low pressure drop and require simple maintenance, but their efficiencies are quite low for particles smaller than 50 <math>\mu\text{m}</math>. Since most of the troublesome particles have much smaller sizes than 50 <math>\mu\text{m}</math> these devices are normally used as precleaners prior to passing the gas stream through high efficiency collection devices.</p> 	2
b	<p><b>Sources of biomedical waste</b></p> <ul style="list-style-type: none"><li>• Hospital</li><li>• Pathological labs</li><li>• Research centers</li></ul>	2



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	<p><b>Treatment methods</b></p> <ul style="list-style-type: none"><li>• Mechanical method</li><li>• Thermal method: autoclaving, microwave treatment, incineration, plasma system</li><li>• Chemical method</li><li>• Irradiation method</li><li>• Biological method.</li></ul>	2
c	<p><b>3R principle</b></p> <p><b>Reuse:</b> In today's world use and through materials is increasing and hence solid waste. Instead of throwing that material or item if it is used again, energy and environment can be saved. Solid waste generation also will be reduced. In industry various boxes, cans, pallets etc are used for material handling. These can be used again for same purpose. e.g. Catalyst drums can be used again to fill catalyst.</p> <p><b>Recycle :</b> Recycling is a process to change materials (waste) into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution (from incineration) and water pollution (from landfilling) by reducing the need for "conventional" waste disposal, and lower greenhouse gas emissions as compared to plastic production. Recycling is a key component of modern waste reduction and is the third component of the "Reduce, Reuse, and Recycle" waste hierarchy. Recyclable materials include many kinds of glass, paper, metal, plastic, textiles, and electronics. In the strictest sense, recycling of a material would produce a fresh supply of the same material-for example, used office paper would be converted into new office paper, or used foamed polystyrene into new polystyrene. e.g. Plastic water bottles can be recycled to get plastic again.</p> <p><b>Reduce:</b> When you avoid making garbage in the first place, you don't have to worry about disposing of waste or recycling it later. Changing your habits is the key - think about ways you can reduce your waste when you shop, work and play. There's a ton of ways for you to reduce waste, save yourself some time and money, and be good to the Earth at the same time. Buy products in bulk. Larger, economy-size products or ones in concentrated form use less packaging and usually cost less per ounce.</p>	4





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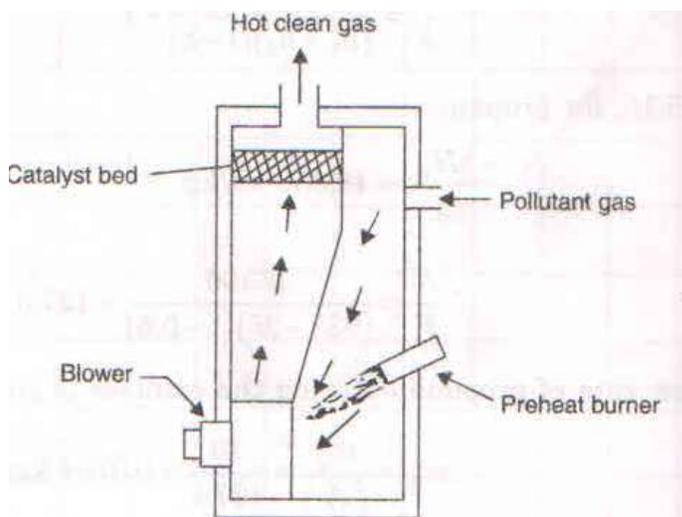
order to make use of its value as a soil conditioner and fertilizer. Since sludge may contain toxic industrial chemicals, it is not spread on land where crops are grown for human consumption.

Where a suitable site for land disposal is not available, as in urban areas, sludge may be incinerated. Incineration completely evaporates the moisture and converts the organic solids into inert ash. The ash must be disposed of, but the reduced volume makes disposal more economical. Air pollution control is a very important consideration when sewage sludge is incinerated. Appropriate air-cleaning devices such as scrubbers and filters must be used.

Dumping sludge in the ocean, once an economical disposal method for many coastal communities, is no longer considered a viable option. It is now prohibited in the United States.

f **Incineration** is a waste treatment process that involves the combustion of organic substances contained in waste materials to convert to CO<sub>2</sub> and water.

**Catalytic Incinerator**



1

3

6

Attempt any four of the following

16



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a	<p><b>Effect of air pollution on human health</b></p> <p><b>1) Sulfur dioxide (SO<sub>2</sub>) :</b></p> <p>i) SO<sub>2</sub> is an irritant gas which can easily get oxidized to sulfur trioxide and in the presence of water, these can form sulfurous and sulfuric acid</p> <p>ii) The health problems related to the mucous membrane and respiratory tract are due to sulfate aerosols.</p> <p>iii) Chronic effects of SO<sub>2</sub> include increased probabilities of bronchitis, "colds" of long duration and suppression of immune system.</p> <p><b>2) Hydrocarbons :</b></p> <p>iv) The health effects of hydrocarbons have been noted in occupational exposures to tetra methyl lead, benzene, etc.</p> <p>v) Inhaling formaldehyde can cause irritation.</p> <p>vi) It is a major contributor to eye and respiratory irritation caused by photochemical smog.</p> <p><b>3) Carbon monoxide :</b></p> <p>vii) Carbon monoxide has a great affinity for the hemoglobin in the blood and combines with blood to form carboxyhemoglobin. This reduces the ability of hemoglobin to carry oxygen to the body tissues.</p> <p><b>4) Oxide of Nitrogen:</b></p> <p>viii) NO reduces the oxygen carrying capacity of blood.</p>	4
b	<p><b>Freeze out Sampling</b></p> <p>In freeze out sampling a series of cold traps, which are maintained at progressively lower temperature, are used to draw the air sample, whereby the pollutants are condensed. The traps are brought to the laboratory, the samples are removed and analysed by means of gas chromatographic, infrared or ultraviolet, spectrophotometer, and mass spectrometry or by wet chemical means. Disadvantages: Plugging of the system because of Ice formation. Coolant used are Ice-water 0 Ice-salt -21 Dry ice and acetone -79 Liquid air -147 Liquid oxygen -183 Liquid nitrogen -196</p>	4



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c	<p><b>Significance of BOD and COD</b></p> <p><b>BOD:</b> - It is the amount of oxygen required to degrade organic waste present in water by purely biological means.</p> <p>The biological oxygen demand, ie, BOD in wastewater, is a measure of the quantity of bio-organic substances in wastewater. These can be in the form of fat, oils, carbohydrates and proteins. BOD also helps determine the quantum of organic chemicals contained in wastewater that are synthetic and biodegradable</p> <p><b>COD:</b> - It is the amount of oxygen required to degrade organic waste present in water by purely chemical means.</p> <p>COD can help gauge the quantum of both biodegradable and non-biodegradable organics. It is quick method to determine strength of waste in water. Strength of waste waster can be finding out by knowing COD value.</p>	1 1 1 1
d	<p><b>Methods for pollution control in fertilizer industry</b></p> <p>Various pollutants are generated from fertilizer complex which consist of ammonia, nitric acid, urea, ammonium sulphate etc. From these plants following pollutants are generated.</p> <p>a) Oil and grease</p> <p>b) Oxides of nitrogen</p> <p>c) Oxides of sulfur</p> <p>d) Particulate matter.</p> <p>e) Liquid effluents consisting of various raw material and products</p> <p>Tail gas treatment method is required to reduce oxides of nitrogen from nitric acid plant. Bag filter and cyclone separator is used for particulate control. Activated sludge treatment method is used for treatment of waste water.</p>	4
e	<p><b>Secondary treatment for waste water</b></p> <ul style="list-style-type: none"><li>• Degrade biological content (dissolved organic matter) of the sewage</li></ul>	1 mark each for any four



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		<p>Ex: human waste, food waste, soaps, detergent</p> <ul style="list-style-type: none"><li>• Activated sludge</li><li>• Aerated lagoons</li><li>• Aerobic granulation</li><li>• Constructed wetland</li><li>• Membrane bioreactor</li><li>• Trickling filter</li><li>• Rotating biological contactor</li></ul>	
f	<p><b>Segregation of bio medical waste</b></p> <p>No untreated bio-medical waste shall be mixed with other wastes.</p> <p>The bio-medical waste shall be segregated as per categories applicable, into containers or bags at the point of generation e.g., all patient care activity areas, diagnostic service areas, operation theatre areas, treatment rooms etc. prior to its storage, transportation, treatment and disposal. Containers and bags are labeled with relevant bio-hazard symbol. Waste is segregated into colour coded bags as specified. Bins used for holding the colour coded bags should be of the same colour. In case a bin of the same colour is not available due to some reason, a neutral colour bin may be used with a prominent sticker of the colour of the bag pasted on the lid and/or body. The size of the sticker must be approximately of half the size of the lid of the bin. All bags, containers or bins directly used in the collection of bio-medical wastes are labeled with appropriate Hazard Symbol</p> <p><b>Storage</b></p> <p>The collection of biomedical waste involves use of different types of container from various sources of biomedical wastes like Operation Theatre, laboratory, wards, kitchen, corridor etc. The containers/ bins should be placed in such a way that 100 % collection is achieved. Sharps must always be kept in puncture-proof containers to avoid injuries and infection to the workers handling them.</p> <p>Once collection occurs then biomedical waste is stored in a proper place. Segregated wastes of different categories need to be collected in identifiable containers. The duration of storage should not exceed for 8-10 hrs in big hospitals (more than 250 bedded) and 24</p>	4	



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hrs in nursing homes. Each container may be clearly labelled to show the ward or room where it is kept. The reason for this labelling is that it may be necessary to trace the waste back to its source. Besides this, storage area should be marked with a caution sign.

**Transportation**

The waste should be transported for treatment either in trolleys or in covered wheelbarrow. Manual loading should be avoided as far as possible. The bags / Container containing BMWs should be tied/ lidded before transportation. Before transporting the bag containing BMWs, it should be accompanied with a signed document by Nurse/ Doctor mentioning date, shift, quantity and destination.

Special vehicles must be used so as to prevent access to, and direct contact with, the waste by the transportation operators, the scavengers and the public. The transport containers should be properly enclosed. The effects of traffic accidents should be considered in the design, and the driver must be trained in the procedures he must follow in case of an accidental spillage. It should also be possible to wash the interior of the containers thoroughly.